



PATENT
3430-0131P

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

~~APPLICANT(S):~~ HWANG, Kwang-Jo ~~CONF.:~~ 5562
~~SERIAL NO.:~~ 09/648,111 ~~GROUP:~~ 2815
~~FILED:~~ August 25, 2000 ~~EXAMINER:~~ Brock II, P.
~~FOR:~~ METHOD OF PATTERNING A METAL LAYER IN A
SEMICONDUCTOR DEVICE

#18 / Reg. for
Reconsideration
Drew
6.5.03

REQUEST FOR CONSIDERATION

Assistant Commissioner for Patents
Washington, D.C. 20231

May 27, 2003

Dear Sir:

In response to the non-final Office Action dated February 25, 2003, the following remarks are respectfully submitted in connection with the above-identified application.

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REQUEST FOR RECONSIDERATION

Upon entry of this Amendment, claims 1-11 and 13-31 will be pending in the present application. Claims 1, 22, 30 and 31 are independent claims. Reconsideration and allowance of the application are respectfully requested.

Rejections Under 35 U.S.C. § 103

Claims 1, 2, 5-9, 11,13, 15, 16, 20-22, 24 and 28-31 stand rejected under 35 U.S.C. §103(a) over U.S. Patent No. 5,771,110 to Hirano et. al.

(Hirano) in view of U.S. Patent No. 6,133,145 to Chen, and claims 10, 17-19 and 25-27 stand rejected under 35 U.S.C. 103(a) over Hirano and Chen as applied to claims 1, 22 and 30 in view of U.S. Patent No. 5,968,847 to Ye et al. (Ye). These rejections are respectfully traversed.

The Examiner admits that Hirano fails to teach treating the exposed portion of the metal layer with a first plasma prior to etching. In order to supply the vacancy of Hirano, the Examiner asserts that Chen teaches treating the exposed portion of the metal layer with a first plasma prior to etching. However, without conceding the propriety of the Examiner's position, it still remains that the treatment of the exposed portion of the designated metal layer of Chen with a first plasma does not lower a binding force in the exposed portion.

Particularly, Chen describes a plasma treatment, in a nitrogen containing ambient, applied to the photoresist shape, prior to the metal etch cycle. The plasma treatment of the photoresist shape slows the removal rate thereof, in a specific etchant, while maintaining the desired removal rate of the exposed metal (see Chen, Col.1, lines 29-39).

Based on the above-recited portion of Chen, it is clear that of the choices available to maintain a high etch selectivity between the metal and the photoresist, Chen chose to increase a binding force in the photoresist shape. It could have been equally reasonable to make a choice of lower a binding in the metal prior to the etch cycle so that the etch rate of the metal would be increased rather than the etch rate of the photoresist being decreased.

However, it is clear that Chen chose not to lower a binding force in the metal to obtain or maintain the desired high selectivity, but rather, Chen chose to increase a binding force in the photoresist. The direct quote from Chen, extracted from the preceding paragraph, is the “plasma treatment of the photoresist shape, slows the removal rate of the photoresist shape, in a specific etchant, while maintaining the desired removal rate of the exposed metal” (emphasis added).

Therefore, the binding force in the metal is kept constant, while the binding force in the photoresist is increased. Clearly then, Chen fails to disclose or suggest treating the exposed portion of the metal layer with a first plasma, prior to any step of etching said photoresist pattern, and prior to any step of etching said metal layer, using the photoresist pattern as a mask, to lower a binding force in the exposed portion, as recited in independent claim 1, and similarly stated in independent claims 1, 22, 30 and 31. In fact, in a case such as this one, the selection of one option, when two are available, amounts to teaching away from the option not selected.

Discussion of Examiner's Response to Applicant's Arguments

In the Examiner's “Response to Arguments” in the current Office Action, the Examiner has chosen to designate layer 10a as the metal layer having an exposed portion treated with a first plasma, prior to etching. The Applicant's claims require that in a certain step of the claimed method, a photoresist

pattern must be formed on the said metal layer, such that a portion of the metal layer is exposed. In this case, the said metal 10a has a photoresist patterned formed thereon. The Examiner has argued extensively that the subject photoresist pattern is photoresist pattern 12b (and not 12a).

Therefore, since the Examiner has designated layer 10a as a metal layer having an exposed portion treated with a first plasma, and also strongly asserted that the subject photoresist pattern is photoresist pattern 12b, the Applicant now opposes the Examiner's position in accordance with the Examiner's designations.

Applicant's independent claim 1 recites forming a photoresist pattern on the metal layer, such that a portion of the metal layer is exposed. Therefore, Applicant examines herein a question of whether Chen teaches that photoresist pattern 12b is formed on metal layer 10a. Referring to Fig.4 metal layer 10a is disposed between layer 9a and layer 11a. Photoresist pattern 12b does not exist in Fig.4, and therefore it is not possible that Fig.4 teaches that photoresist pattern 12b is formed on metal layer 10a. Referring to Fig.5, both metal layer 10a and photoresist pattern 12b are shown. However, photoresist pattern 12b is not formed on metal layer 10a, but rather, it is formed on titanium nitride layer 11b. Hence, even before the issue of lowering a binding force in the metal is reached, a photoresist pattern is not formed on the designated metal layer of Chen.

Therefore, it is clear that (based on the Examiner's designations), Chen fails to disclose or suggest either forming a photoresist pattern on the metal layer, such that a portion of the metal layer is exposed or treating the exposed portion of the metal layer with a first plasma, prior to any step of etching said photoresist pattern, and prior to any step of etching said metal layer, using the photoresist pattern as a mask, to lower a binding force in the exposed portion, as recited in independent claim 1, and similarly stated in independent claims 22, 30 and 31. Neither Chen, nor Ye, can fill this vacancy.

Claims 2, 5-9, 11, 13, 15, 16, 20, 21, 24, 28 and 29 depend, either directly or indirectly, on claims 1, 22 and 30. Since neither Hirano, nor Chen, discloses or suggest the features of independent claims 1, 22, 30 and 31, Hirano, in view of Chen, cannot render claims 1, 2, 5-9, 11, 13, 15, 16, 20-22, 24 and 28-31 obvious to one of ordinary skill in the art.

Claims 10, 17-19, and 25-27, also depend on claims 1, 22, and 30. Since neither Hirano, nor Chen, nor Ye discloses or suggests the features of independent claims 1, 22, and 30, Hirano and Chen, in view of Ye, cannot render claims 10, 17-19 and 25-27 obvious to one of ordinary skill in the art.

Reconsideration and withdrawal of these art grounds of rejection is respectfully requested.

Conclusion

Applicant considers all of the Examiner's comments to have been addressed and all of the Examiner's rejections overcome, thereby placing all

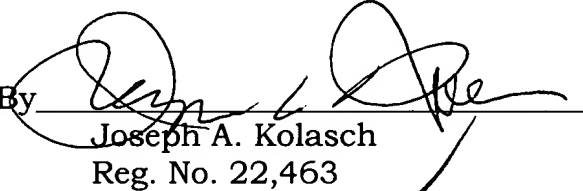
claims pending in the present Application in condition for allowance. Accordingly, a Notice of Allowability is solicited in earnest.

In the event that any outstanding matters remain in this application, Applicant requests that the Examiner contact Percy L. Square (Reg. No. 51,084) at (703) 205-8034 to discuss such matters.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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By 
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- ☐ Petition for () month(s) extension of time pursuant to 37 C.F.R. §§ 1.17 and 1.136(a). \$0.00 for the extension of time.
- ☒ No fee is required.
- ☐ Check(s) in the amount of \$0.00 is(are) enclosed.
- ☐ Please charge Deposit Account No. 02-2448 in the amount of \$0.00. This form is submitted in triplicate.


If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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Attachment(s)

(Rev. 04/30/03)